

Appl. No. 09/919,994
Amdt. dated September 11, 2006
Reply to Office Action of June 15, 2006

Amendments to the Claims:

Listing of Claims:

1. (Currently Amended) A process for reducing the amount of residual diphenylmethane diisocyanate monomer in a polyurethane prepolymer reaction product comprising the steps of:
 - (A) dissolving diphenylmethane diisocyanate monomer in one or more inert solvents, said solvent or solvents being selected from the group consisting of solvents having a boiling point about 1°C to about 100°C below the boiling point of the diphenylmethane diisocyanate monomer at a pressure of 10 torr, wherein the weight ratio of the inert solvent or solvents to the diphenylmethane diisocyanate monomer ranges from about 75:25 to about 35:65,
 - (B) adding at least one polyol to a stoichiometric excess of the dissolved diphenylmethane diisocyanate monomer at an NCO:OH ratio in the range of from about 2:1 to 20:1,
 - (C) reacting said polyol(s) with said dissolved diphenylmethane diisocyanate monomer to form a mixture comprising polyurethane prepolymer reaction product and unreacted diphenylmethane diisocyanate, and
 - (D) distilling the mixture comprising polyurethane prepolymer reaction product and unreacted diphenylmethane diisocyanate to strip the unreacted diphenylmethane diisocyanate to a level less than 0.3% by weight based on the combined weight of prepolymer, residual monomer, and residual inert solvent,

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wherein the inert solvent or solvents comprise about 5% to about 85% by weight of the total weight of the combination of the mixture for forming the prepolymer reaction product plus solvents and wherein all solvent(s) employed in ~~said process~~ step (D) have a boiling point about 1°C to about 100°C below the boiling point of the diphenylmethane diisocyanate monomer at a pressure of 10 torr.

2. (Previously Presented) The process of claim 1 wherein the monomeric diphenylmethane diisocyanate is at least one isomer of diphenylmethane diisocyanate.
3. (Previously Presented) The process of claim 2 wherein the inert solvent or solvents are selected from the group consisting of organic aromatic esters, aliphatic esters, and mixtures thereof having boiling points in the range of from about 115°C to about 214°C at 10 torr.
4. (Previously Presented) The process of claim 2 wherein the distillation step comprises at least three agitated film vacuum distillation stages in series, each at an evaporative temperature of up to 150°C.
- 5 - 6. (Canceled)

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7. (Previously Presented) The process of claim 1 wherein the prepolymer contains less than 0.1% by weight of unreacted diphenylmethane diisocyanate monomer based on the combined weight of prepolymer, residual monomer, and residual solvent after stripping.

8. (Previously Presented) The process of claim 1 wherein the prepolymer contains less than 0.05% by weight of unreacted diphenylmethane diisocyanate monomer\ based on the combined weight of prepolymer, residual monomer, and residual solvent after stripping and containing at least 80% of the theoretical NCO content for a pure ABA structure.

9. (Previously Presented) The process of claim 1 wherein at least one polyol is selected from the group consisting of a polyester of adipic acid; a polyether of ethylene oxide, propylene oxide, or tetrahydrofuran; a polycaprolactone; a polycarbonate; a hydrocarbon polyol; and mixtures thereof; said polyol having a number average molecular weight in the range of from about 400 to about 5000.

10. (Previously Presented) The process of claim 1 wherein the polyol comprises at least one component having a low molecular weight in the range of from about 62 to about 400, and selected from the group consisting of ethylene glycol, isomers of propylene glycol, isomers of butane diol, hexanediol, trimethylolpropane, pentaerythritol, poly(tetramethylene ether) glycol, diethylene glycol, triethylene glycol, dipropylene glycol, tripropylene glycol, and mixtures thereof.

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11. (Previously Presented) The process of claim 10 further comprising at least one polyol having a high number average molecular weight in the range of from about 400 to about 5000.

12. (Previously Presented) The process of claim 11 wherein the molar ratio of the low molecular weight polyol to the high number average molecular weight polyol is in the range of from about 0.25 to about 2.5:1.

13. (Canceled)

14. (Withdrawn) A polyurethane elastomer comprising the reaction product of i) a prepolymer terminated with diphenylmethane diisocyanate, said prepolymer comprising no more than about 0.3% free diphenylmethane diisocyanate and having at least about 80% of theoretical NCO content for pure ABA structure with ii) a chain extender selected from the group consisting of 1,4-butanediol; 1,3-propanediol; ethylene glycol; 1,6-hexanediol; hydroquinone-bis-hydroxyethyl ether; resorcinol di(beta-hydroxyethyl) ether; resorcinol di(beta-hydroxypropyl) ether; 1,4-cyclohexane dimethanol; an aliphatic triol; an aliphatic tetrol; 4,4'-methylene-bis(2-chloroaniline); 4,4'-methylene-bis(3-chloro-2,6-diethylaniline); diethyl toluene diamine; t-butyl toluene diamine; dimethylthio-toluene diamine; trimethylene glycol di-p-amino-benzoate; methylenedianiline; methylenedianiline-sodium chloride complex; and mixtures thereof;

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wherein the equivalent ratio of prepolymer to chain extender is in the range of from about 0.7:1 to about 1.2:1.

15. (Withdrawn) The elastomer of claim 14 wherein at least one chain extender is selected from the group consisting of trimethylene glycol di-p-amino-benzoate; 4,4'-methylene-bis(3-chloroaniline); 4,4'-methylene-bis(3-chloro-2,6-diethylaniline); diethyl toluene diamine; and dimethylthio-toluene diamine.

16. (Withdrawn) The elastomer of claim 14 wherein the chain extender is trimethylene glycol di-p-amino-benzoate.

17. (Withdrawn) The elastomer of claim 14 wherein the chain extender is 4,4'-methylene-bis(2-chloroaniline).

18. (Withdrawn) The elastomer of claim 14 wherein the chain extender is diethyl toluene diamine.

19. (Withdrawn -Previously Presented) A polyurethane elastomer comprising the reaction product of:

A) a diphenylmethane diisocyanate-terminated prepolymer comprising the reaction product of:

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i) a first polyol comprising at least one component having a low molecular weight in the range of from about 62 to about 400, and selected from the group consisting of ethylene glycol, isomers of propylene glycol, isomers of butane diol, hexanediol, trimethylolpropane, pentaerythritol, poly(tetramethylene ether) glycol, diethylene glycol, triethylene glycol, dipropylene glycol, tripropylene glycol, and mixtures thereof;

ii) a second polyol having a high molecular weight in the range of from about 400 to about 5000; and

iii) a stoichiometric excess of diphenylmethane diisocyanate monomer at an NCO:OH ratio in the range of from about 2:1 to about 20:1; wherein unreacted diphenylmethane diisocyanate monomer is removed from said reaction product by a process comprising distilling the reaction product in the presence of at least one inert solvent having a boiling point about 1°C to about 100°C below the boiling point of the diphenylmethane diisocyanate monomer at a pressure of 10 torr, wherein the weight ratio of the inert solvent to the diphenylmethane diisocyanate monomer ranges from about 90:10 to about 10:90, and the inert solvent comprises about 5% to about 85% by weight of the total weight of the combination of the prepolymer reaction product mixture plus solvents; with

B) a chain extender selected from the group consisting of 1,4-butanediol; 1,3-propanediol; ethylene glycol; 1,6-hexanediol; hydroquinone-bis-hydroxyethyl ether; resorcinol di(beta-hydroxyethyl) ether; resorcinol di(beta-hydroxypropyl) ether; 1,4-cyclohexane dimethanol; aliphatic triols; aliphatic tetrols; 4,4'-methylene-bis(2-chloroaniline); 4,4'-methylene-bis(3-chloro-2,6-diethylaniline); diethyl toluene diamine;

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t-butyl toluene diamine; dimethylthio-toluene diamine; trimethylene glycol di-p-amino-benzoate; methylenedianiline; methylenedianiline-sodium chloride complex; and mixtures thereof;

wherein the equivalent ratio of chain extender to prepolymer is in the range of from about 0.7:1 to about 1.2:1.

20. (Withdrawn) A wheel or roll comprising a core and a polyurethane cover wherein the cover comprises the reaction product of :

A) a prepolymer comprising the reaction product of a polyol and diphenyl methane diisocyanate wherein excess diphenyl methane diisocyanate has been removed to less than 2 wt%, and

B) an amine or diol chain extender.

21. (Withdrawn) The wheel or roll of claim 20 wherein the amine or diol chain extender is selected from the group consisting of 1,4-butanediol; 1,3-propanediol; ethylene glycol; 1,6-hexanediol; hydroquinone-bis-hydroxyethyl ether; resorcinol di(beta-hydroxyethyl) ether; resorcinol di(beta-hydroxypropyl) ether; 1,4-cyclohexane dimethanol; an aliphatic triol; an aliphatic tetrol; 4,4'-methylene-bis(2-chloroaniline); 4,4'-methylene-bis(3-chloro-2,6-diethylaniline); diethyl toluene diamine; t-butyl toluene diamine; dimethylthio-toluene diamine; trimethylene glycol di-p-amino-benzoate; methylenedianiline; methylenedianiline-sodium chloride complex; and mixtures thereof.

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22. (Withdrawn) A wheel or roll comprising a core and a polyurethane cover wherein the cover comprises a polyurethane elastomer comprising the reaction product of i) a prepolymer terminated with diphenylmethane diisocyanate, said prepolymer comprising no more than about 0.3% free diphenylmethane diisocyanate and having at least about 80% of theoretical NCO content for pure ABA structure with ii) a chain extender selected from the group consisting of 1,4-butanediol; 1,3-propanediol; ethylene glycol; 1,6-hexanediol; hydroquinone-bis-hydroxyethyl ether; resorcinol di(beta-hydroxyethyl) ether; resorcinol di(beta-hydroxypropyl) ether; 1,4-cyclohexane dimethanol; an aliphatic triol; an aliphatic tetrol; 4,4'-methylene-bis(2-chloroaniline); 4,4'-methylene-bis(3-chloro-2,6-diethylaniline); diethyl toluene diamine; t-butyl toluene diamine; dimethylthio-toluene diamine; trimethylene glycol di-p-amino-benzoate; methylenedianiline; methylenedianiline-sodium chloride complex; and mixtures thereof; wherein the equivalent ratio of prepolymer to chain extender is in the range of from about 0.7:1 to about 1.2:1.

23. (Withdrawn) A golf ball comprising a core and a cover, where the cover is a polyurethane elastomer comprising the reaction product of:

- A) a prepolymer comprising the reaction product of a polyol and diphenyl methane diisocyanate wherein excess diphenyl methane diisocyanate has been removed to less than 2 wt%, and
- B) at least one hydroxy or amine functional chain extender.

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24. (Withdrawn) The golf ball of claim 23 wherein the amine or diol chain extender is selected from the group consisting of 1,4-butanediol; 1,3-propanediol; ethylene glycol; 1,6-hexanediol; hydroquinone-bis-hydroxyethyl ether; resorcinol di(beta-hydroxyethyl) ether; resorcinol di(beta-hydroxypropyl) ether; 1,4-cyclohexane dimethanol; an aliphatic triol; an aliphatic tetrol; 4,4'-methylene-bis(2-chloroaniline); 4,4'-methylene-bis(3-chloro-2,6-diethylaniline); diethyl toluene diamine; t-butyl toluene diamine; dimethylthio-toluene diamine; trimethylene glycol di-p-amino-benzoate; methylenedianiline; methylenedianiline-sodium chloride complex; and mixtures thereof

25. (Withdrawn) A golf ball comprising a core and a polyurethane cover wherein the cover comprises a polyurethane elastomer comprising the reaction product of i) a prepolymer terminated with diphenylmethane diisocyanate, said prepolymer comprising no more than about 0.3% free diphenylmethane diisocyanate and having at least about 80% of theoretical NCO content for pure ABA structure with ii) a chain extender selected from the group consisting of 1,4-butanediol; 1,3-propanediol; ethylene glycol; 1,6-hexanediol; hydroquinone-bis-hydroxyethyl ether; resorcinol di(beta-hydroxyethyl) ether; resorcinol di(beta-hydroxypropyl) ether; 1,4-cyclohexane dimethanol; an aliphatic triol; an aliphatic tetrol; 4,4'-methylene-bis(2-chloroaniline); 4,4'-methylene-bis(3-chloro-2,6-diethylaniline); diethyl toluene diamine; t-butyl toluene diamine; dimethylthio-toluene diamine; trimethylene glycol di-p-amino-benzoate; methylenedianiline; methylenedianiline-sodium chloride complex; and mixtures thereof;

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wherein the equivalent ratio of prepolymer to chain extender is in the range of from about 0.7:1 to about 1.2:1.

26. (Withdrawn) A multicomponent system for producing polyurea-urethane elastomers comprising

- A) a prepolymer comprising the reaction product of a polyol and diphenyl methane diisocyanate wherein excess diphenyl methane diisocyanate has been removed to less than 2 wt%, and
- B) methylene dianiline or its complex with sodium chloride.

27. (Canceled)

28. (Withdrawn) A thermoplastic urethane elastomer comprising the reaction product of

- A) a prepolymer comprising the reaction product of a polyol and diphenyl methane diisocyanate wherein excess diphenyl methane diisocyanate has been removed to less than 2 wt%, and
- B) at least one hydroxy or amine functional chain extender.

29. (Previously Presented) The process of claim 1 wherein the inert solvent or solvents are selected from the group consisting of dimethyl phthalate, diethyl phthalate, diisobutyl adipate, and dibutyl phthalate.

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30 - 31. (Canceled)

32. (Previously Presented) The process of claim 1 further comprising the step of adding at least one blocking agent selected from the group consisting of a ketoxime, a phenol, a lactam, or a pyrazole to the stripped prepolymer.